

Semicircular canal size and upright stance: a comparative perspective. R. B. ECKHARDT and A. H. HILDEBRAND, The Pennsylvania State University, University Park, PA 16802.

Recently it has been argued that modern human locomotor behavior makes particular demands on the vestibular apparatus because it involves the maintenance of an upright body posture by balancing on very small areas of support. It has been argued further that increased sensitivity of the vertically oriented anterior and posterior canals in humans would make sense because the role of the vestibular system in coordinating bipedal behavior through the vestibular reflexes particularly involves monitoring body movements in the vertical plane.

As an independent test of these interrelated hypotheses, birds were chosen as a reference sample because, like humans, they are bipedal when engaging in terrestrial locomotion. Furthermore, in contrast to extant humans which are monospecific and present a limited body size range, birds are diverse taxonomically and dimensionally. The main comparative data set used in this analysis comprised vestibular radii for 20 species of birds, along with foot dimensions and body mass. Relationships among logs of body mass, foot length and each of three semicircular canal radii were examined after checking for bivariate normal distributions among pairs of dimensions. Correlations between logs of foot length and semicircular canal radii ranged from moderately negative (-0.215 for log lateral canal radius) through moderately positive (+0.105 for log anterior canal radius) but were consistently lower than respective correlations between logs of the same canal dimensions and log body mass; no correlations attained significance at the 0.05 level. Our results provide no support for the suggested relationship between foot platform area and vestibular system dimensions, but fit wider findings suggesting that the contribution of the vestibular system, while complex, is not in directly sensing movement of the body, but rather movement of the head itself.

Inter- and intra-population variation in the pattern of male testosterone by age. P. T. ELLISON, S. F. LIPSON, Harvard University, Cambridge, MA, R. G. BRIBIESCAS, Massachusetts General Hospital, Boston, MA, G. R. BENTLEY, Cambridge University, Cambridge UK, B. C. CAMPBELL, Northwestern University, Evanston, IL, C. PANTER-BRICK, Durham University, Durham, UK

There has been some controversy over age patterns of testosterone in men. Unlike serum testosterone values, salivary testosterone, which represents free, unbound circulating testosterone, usually shows a clear

pattern of decline from the early twenties in western populations. Comparable data from non-western populations have been lacking, however. This study considers patterns of age variation in male salivary testosterone from four populations -- from Boston (N = 106), Zaire (N = 33), Nepal (N = 45), and Paraguay (N = 78) -- all generated in the same laboratory following the same protocols.

The results suggest that variation between populations in average levels of salivary testosterone is primarily a consequence of variation among young (< 35 yr) men, while the levels of testosterone among older men vary much less across populations. In populations with high average testosterone levels, the slope of testosterone with age is more strongly negative than in populations with low average testosterone levels. The same trend occurs between seasons within populations, although the differences are slight in magnitude.

This pattern of age variation in male testosterone between populations contrasts with the constancy of the age pattern in female progesterone across populations. Further investigation of comparative data on male gonadal function may illuminate our understanding of male reproductive aging, changes in body composition, and age-related disease.

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Growing Up: Defining Adolescence for Female Savanna Baboons (*Papio cynocephalus*). E.M. ERHART. Department of Sociology and Anthropology, Southwestern University, Georgetown, TX 78627; Department of Anthropology, Southwest Texas State University, San Marcos Texas, 78666.

Studies of sex differences in primate behavioral development typically focus on the perinatal, infant and adult stages. As a result, we know remarkably little about the ways in which different patterns of behavior, and changing relationships between behavioral components, emerge out of previous patterns. One period of life in which we might expect to find such reorganization is adolescence which is characterized by rapid and often dramatic physiological and social change. I examined the behavior of adolescent female savanna baboons whose adolescence had not been cut short by pregnancy and parturition, and who had been experimentally deprived of the opportunity to learn parent or aunt behavior. In the absence of the stimuli associated with infants and the influence of adult female role models, one would not expect the extreme behavioral sex differences seen in reproductive groups.

The adolescent and adult baboons study subjects were part of the primate colony at the Southwest Foundation for Biomedical Research, San Antonio Texas. Adolescence was operationally defined as the subadult period which occurs between 43 and 72 to 96 months of age. Focal animal sampling resulted in at least 60 10-minute sessions (range: 60-75) for each adolescent and adult subject. Comparisons between subjects were made using mean rates per hour of sampling, and level of significance was set at  $\leq .05$ .

I found significant sex and age differences for several social behaviors. For example, adolescent females and

males differed in their behavioral performance for Avoid, Groom and Present (females > males), and for Displace, Follow and Hip Touch (males > females). These adolescent behavioral sex differences mirror those of the adult baboon subjects. However, rates of behavior for adolescent males differed from those of adult males for several behaviors including Follow, Groom, Social Approach, Play Face, and Displace. Conversely, by 43 months of age the behavioral rates of adolescent females were not different from those of adult females for any of the behaviors sampled. Adolescent female baboons may make a shift from immature behavioral activity rates to at least some adult levels of activity before physical maturation is complete. Decline in frequency of some energetically costly behaviors, and early behavioral maturation in others, may be linked to early reproduction in female savanna baboons, and female primates in general.

**The angle of the Neandertal *sulcus processus zygomaticus* and masticatory muscle function.** T. L. Estenson and J. Y. Anderson, University of New Mexico, Albuquerque, NM 87131.

A recent comparative analysis of the angle of the *sulcus processus zygomaticus* relative to the Frankfort Horizontal found it significantly greater in Neandertals than in modern humans or prehistoric groups (Elyaqine 1995). This study concluded that the steeper incline; 1] increased the anterior-posterior diameter of the temporal fossa, 2] allowed more fibers of the posterior temporalis muscle fibers to insert on the rear of the coronoid process and at a more oblique angle, and, 3] increased the vertical vector of the posterior temporalis and decreased its horizontal component. It was proposed that these differences increased the biomechanical advantage of temporalis in this prognathic group.

The present study examined crania of historic and prehistoric modern humans as well as of fossil groups. It confirmed the greater angle of inclination in Neandertal. However, it found that a greater angle insignificantly affected the anterior-posterior diameter of the temporal fossa (point 1] above). It was also noted that the angle would only trivially effect the orientation and extent of posterior temporalis fiber insertions on the coronoid process (point 2] above). Additionally, the orientation and mandibular attachments of the temporalis were studied in dissections of modern humans. The tendons of the posterior temporalis muscle fibers may insert on the coronoid either directly or through indirect attachments to the central coronoid tendon. Functional vectors are determined primarily by the nature of these tendinous insertions and are not affected by the sulcus or its inclination (point 3] above).

The findings of this study do not support any of the three conclusions above. The angle of the *sulcus processus zygomaticus* has little effect on the function of the temporalis muscle. It is more likely that this area of the temporal bone is designed to support the zygomatic arch. The increased angle of inclination results from the bolstering of the zygomatic process to withstand stress from masseteric muscle function.

Radiation and evolution of macaques in the Indo-Malay region. B. J. EVANS, Department of Biological Sciences, Center for Environmental Research and Conservation, J. C. MORALES, Center for Environmental Research and Conservation, Department of Anthropology, D. J. MELNICK, Department of Biological Sciences, Center for Environmental Research and Conservation, Department of Anthropology, Columbia University, NY

The depauperate faunal composition of the Indonesian island of Sulawesi in comparison to the neighboring Sunda islands of Borneo, Sumatra, and Java reflects one of the most formidable biogeographic barriers in the world. Many taxa that originated on mainland Asia have large distributions that surround Sulawesi, but have never extended to this island. One of the most conspicuous exceptions to this biogeographical barrier is the seven species of endemic monkey (*Macaca*) that are now found on Sulawesi.

Strict female phylopatry of macaques has profound effects on the distribution and evolution of mitochondrial DNA (mtDNA), a matrilineally inherited genetic element, causing sharp geographic clustering of mtDNA haplotypes within a deme. The genetic consequences of this social attribute offer a unique opportunity to examine ancient biogeographic events in macaques by using phylogenetic analysis of mtDNA nucleotide sequences.

In order to examine patterns of colonization, radiation, and diversification of macaques in the Indo-Malay region, we have sequenced over 1300 base pairs of mtDNA including the ND3 and ND4L genes, part of the ND4 gene, and intervening tRNAs, from a wide geographic sample that includes all species of Sulawesi macaque, their parapatric relatives *M. fascicularis* and *M. nemestrina*, and an outgroup taxon, *M. sylvanus*. Analyses of these sequences supports *M. nemestrina* as ancestral to the Sulawesi macaques, a dual invasion of macaques into separate regions of Sulawesi, and a pattern of radiation within Sulawesi that is not completely concordant with the contemporary geography of this island.

Biological affinities of the Buhl Woman: One of the oldest Paleoindian skeletons. T. W. FENTON, University of Arizona, Tucson, AZ 85721, and A. R. NELSON, University of Michigan, Ann Arbor, MI 48109.

The Buhl Woman from southern Idaho, firmly dated at 10,675 ± 95 BP, is among the oldest Paleoindian skeletons ever recovered. The skeleton was that of an adult female estimated to be 17 to 21 years old at the time of death. Based on morphological analyses, the skull exhibited a suite of features consistent with an American Indian biological affinity.

Craniometric assessment of biological

affinity was performed utilizing the University of Michigan Museum of Anthropology (UMMA) Craniofacial Dataset and discriminant function analyses. The UMMA dataset provides the statistical program a total of 43 variables with which to sort and compare sample means and variance profiles. This series of variables is present for approximately 7,200 individuals representing all the major geographic and cultural regions of the world.

Craniometric analysis of the Buhl Woman was based on measurements taken directly from the skull and measurements generated from a series of scaled photographs of the skull. It was determined that Buhl registers most closely with the Amerind, or New World samples, practically to the exclusion of the rest of the world. Buhl does not show any affinities with the European samples, and indicates only a very tenuous connection with the Ainu.

The results of our analyses show the Buhl Woman to have been an American Indian. We believe that, in general, she is not morphologically distinct from later North American Indians. It is our contention that the Buhl Woman is a representative of an early Paleoindian migration that is more closely related to later groups of American Indians than to European or Asian populations.

Encephalization and its developmental structure: how many ways can a brain get big? B.L. FINLAY, M. N. HERSMAN and R.B. DARLINGTON, Developmental Neuroscience Group, Cornell University, Ithaca NY 14853

Ever since Jerison's first account of the structure of variation in the brain size of mammals, every kind of biological scientist has offered further accounts of the forces producing this central relationship, or further description of the variation. In this tradition, we offer a developmental neurobiologist's account of both the forces on and the structure of brain change.

Any substantial change in brain size requires a change in the number of neurons and their supporting elements in the brain, which in turn requires an alteration in either the rate, or the duration of neurogenesis. Previously we showed that the schedule of neurogenesis is surprisingly stable in the mammalian brain, and that an increase in the duration of neurogenesis has a predictable outcome: late-generated structures become disproportionately large (Finlay and Darlington, 1995). We now add new observations to this basic one. First, not only neurogenesis, but also many other features of neural maturation, such as process extension and retraction, cell death, and aspects of physiological function, have the same predictability. Second, changes in rate of neural maturation as well as duration distinguish related groups, such as marsupial and placental mammals, although the underlying structure-by-structure schedule remains the same for changes either in duration or rate. Finally, a substantial part of the regularity of temporal order in neurogenesis can be accounted for in the two

dimensions of the neuraxis, anterior-posterior and alar-basal, as recently recharacterized by Rubenstein, Martinez, Shimamura and Puelles (1994). All of these observations show substantial constraints on the paths brain evolution may take.

Variation of dental microstructural growth markers in the enamel of three modern human populations. C.M. FITZGERALD, Department of Anthropology, McMaster University, 1280 Main St W., Hamilton ON L8S 4L9, Canada

This paper reports on a study in which a large sample of modern human anterior teeth from three populations were longitudinally sectioned, and various aspects of their internal enamel microstructures measured (and where possible also counted). These included circaseptan intervals, distance between adjacent striae of Retzius, and cross striation repeat intervals. The objectives were to establish the range of variability of each of these markers of enamel growth, and to determine to what extent they varied by sampling location within a tooth, by tooth type and size, by sex and by population. Statistical analyses were also carried out on successive pairs of the measured growth structures to try to find relationships that might suggest underlying growth or developmental patterns.

The sample consisted of one hundred and fifty-eight teeth from individuals of determinate age and sex. The three populations were Native Americans, medieval Britons, and contemporary South Africans. Two sections were taken from each tooth and all observations and measurements were made from photomicrographs.

Some of the significant findings were: a) individual circaseptan intervals ranged from 8 to 12 days, with an overall mean of 9.7 days; b) circaseptan intervals did not significantly differ between sexes or amongst populations; c) but inter-population differences in microstructural growth patterns were detected.

The implications of these results are discussed.

Skeletal Anatomy of African Papionins:

Function, Phylogeny or Both?

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Traditionally placed in a single genus, the African mangabeys are now commonly divided into two genera with distinct phylogenetic relationships to other African papionins (e.g., Disotell, 1994). The more terrestrial species of the genus *Cercocebus* are

most closely related to mandrills and drills, while the more arboreal species of the genus *Lophocebus* are more closely related to baboons and geladas. We have examined the skeletal anatomy of mangabeys and other African papionins to see the extent that limb morphology accords with locomotor differences among these monkeys and/or the phyletic relationships suggested by molecular studies.

Species of the more terrestrial *Cercocebus* differ from species of *Lophocebus* in a number of osteological features that separate terrestrial and arboreal primates of other genera, including several features of the proximal and distal humerus, proximal and distal femur, tibia and ankle (see also Nakatsukasa, 1996). However, other aspects of the skeleton, including features of the humeral shaft, elbow region, and tibia, cluster *Cercocebus* with *Mandrillus* and *Lophocebus* with *Papio*. The results of this study suggest that the skeletal anatomy of African papionins reflects both locomotor adaptations and phylogenetic relationships.

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Have male offspring in urban Taiwan benefited disproportionately from recent socioeconomic and demographic changes? B. FLOYD, Department of Anthropology, University of Oregon, Eugene OR 97403-1218.

This study tests two related hypotheses. The first suggests that given the competing interests of family planning and a continued desire for male children among urban parents in Taiwan, female children will have more siblings than their male counterparts, and the statistical association should be stronger among children who do not have an older brother. The second hypothesis suggests that, given such bias, males may benefit disproportionately as socioeconomic status (SES) improves.

These two hypotheses are tested among 937 children born in 1976 and 1977 who attended schools in two different districts within Taipei. Information on a child's stature and sociodemographic background were obtained from individual primary and middle school health records. Chi-square tests are used to examine the association between sex and numbers of siblings. The second hypothesis is tested using analysis of covariance. Height at entry into primary school is the criterion variable with measurement age acting as a covariate. Predictor variables are district, parental educational level (used as a proxy for SES), sex, and an interaction term between parental education and sex.

Results confirm an association between a child's sex and the number of siblings they have. In both districts females had significantly more siblings than males and the statistical

association was stronger among children without an older brother. Support was also found for the second hypothesis. The interaction between parental educational level and sex on stature was statistically significant ( $p \leq .02$ ) along with the other variables in the regression equation. This interaction remained significant even when the number of siblings was included in the equation. While these data suggest that recent socioeconomic and demographic trends have combined with preexisting bias to benefit males disproportionately, they can not rule out the non-mutually exclusive view that females may be better "buffered" against environmental constraints.

The Upper Paleolithic triplex burial of Dolni Vestonice: pathology and funerary behaviour. V. FORMICOLA, A. PONTRANDOLFI, Dept. of Ethology, Ecology and Evolution, University of Pisa, 56126 Pisa, Italy, and J. SVOBODA, Archaeological Institute, Czech Academy of Sciences, 66203 Brno, Czech Republic.

Excavations carried out by Klima and co-workers in the Gravettian site of Dolni Vestonice (Moravia) brought to light in 1986 a triplex burial dated to about 27,000 BP. The burial includes three young individuals buried at the same time. The skeleton in the middle (DV 15) shows severe pathological changes and is very problematic to sex. The other two (DV 13, DV 14) belong to males and lay in an unusual position. The pathology, the young age and the position of the three specimens make this burial unique and have given rise to various speculations about their symbolic significance.

Pathological changes of the DV 15 skeleton include: asymmetric shortening of the femur, bowing of femur and humerus, dysplasias of the sacrum, pubis and vertebral column. Scrutiny of medical literature suggests that the most likely etiological factor is Chondrodysplasia Calcificans Punctata (CCP), a rare inherited disorder characterized by stippled ossification of the epiphyses. The cartilaginous stippling is a transient phenomenon which disappears during infancy, leaving permanent deformities on affected bones. Among the different forms of CCP, the X-linked dominant form is that resulting in asymmetric shortening of the femora and is lethal in males. Thus the disease point to a diagnosis of female sex. Associated clinical findings (erythemas, ichthyosis, alopecia, cataracts and joint contractures, among others) emphasize the singular looks and the "diversity" of this young woman, pointing to a condition that should be carefully taken into account when speculating on the significance of that peculiar burial.

The function of male sexual aggression and female resistance in wild Sumatran orangutans (*Pongo pygmaeus abelii*). E.A. FOX, Biological Anthropology and Anatomy, Duke University, Durham, NC 27708

This study tests predictions of two competing hypotheses for the function of male sexual aggression and female resistance in orangutans: (1) the Mate Assessment Hypothesis and (2) the Female Mate Choice Hypothesis.

Wild orangutans were studied during 24 consecutive months at the Suaq Balimbing Research Station, Sumatra, Indonesia. Over 9,000 hours of observational data were collected from a study population of 51 habituated individuals. All age-sex classes (except infants) were observed to copulate (n=204, plus 7 attempts). Urine was collected from females and analyzed for urinary estrone conjugates (E<sub>1</sub>C) and progesterone (P<sub>4</sub>). Forty-five copulations were analyzed with respect to female hormonal status.

Copulations showed statistically significant differences in the amount and intensity of male aggression, female resistance, and female proceptive behaviors. Behaviors were analyzed using Multidimensional Scalogram Analysis (MSA-1). Results indicate that orangutan copulations can be classified into 3 categories which are scaled according to the degree of aggression used by males, as well as the degree of proceptivity or resistance by females. Females suffer a cost in terms of feeding efficiency on days in which fully forced copulations occur.

Copulations for each female-male dyad were analyzed with respect to: (1) force scale, (2) change over time, and (3) female ovulatory status. The results indicate variation in female mate choice both within and between dyads, as well as variation in relation to the probability of female fertility. These results do not concur with the Mate Assessment Hypothesis, but strongly support the hypothesis that females show active mate choice for individual males.

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The use of computerized tomography in identifying human remains in unexcavated burials. B. FROHLICH, B. FALKOWSKI and N. LYNNEURUP. Dept. of Anthropology, Smithsonian Institution, Washington, D.C. U.S.A.; Siemens Medical Systems, Inc., Training and Development Center, Cary, North Carolina, U.S.A. and Laboratory of Biological Anthropology, Dept. of Forensic Medicine, University of Copenhagen, Denmark

Computerized Axial Tomography (CT scanning) techniques are extensively employed in our organizations to describe and analyze skeletal tissue, soft tissue, mummified tissue, fossils, and cultural objects. CT scanning has allowed us to examine objects in a non-destructive way, otherwise not possible by traditional methods.

More recently, CT scanning has proven to be highly successful in determining the size and shape of human

skeletal remains within unexcavated matrixes of soil. Four infant burials from a Colonial burial ground in St. Johnsbury, Vermont (1790 to 1855) were removed intact and unexcavated in casts consisting of plaster of Paris and plywood. The casts were scanned using Siemens Somatom Plus and A.R.T. equipment at the Siemens Medical Systems in North Carolina and at the Smithsonian Institution. Two millimeters transverse slices were recorded of the entire length of each cast. Siemens Recon Plus software and MPR (Multiple Planar Reconstruction) were used to electronically reconstruct arbitrary oblique slice planes from a selected stack of contiguous transverse tomograms. The approximate coronal slices resulted in a display of the entire skeleton. Maximum lengths of long bones in the upper and lower extremities were recorded by electronically defining the proximal and distal ends. Later exposure of the long bones and subsequent measurements revealed no discrepancies between the measuring methods.

Our results have demonstrated that the application of CT scanning is highly applicable in archaeological, anthropological and forensic cases especially in instances where there may be a request for non-destructive recording. A Siemens A.R.T. scanner, now located at the Natural History Museum at the Smithsonian Institution, has allowed us unrestricted and limitless access to CT technology in a non-medical environment.

Quantification of facial variation in the Papionini (Cercopithecinae, Cercopithecidae). S.R. FROST<sup>1,2,3</sup>, L.F. MARCUS<sup>2,3,4,5</sup>, E. DELSON<sup>1,2,3,5</sup>, D. REDDY<sup>6</sup>. <sup>1</sup>Lehman College, <sup>2</sup>City University of New York Graduate School, <sup>3</sup>New York Consortium in Evolutionary Primatology (NYCEP), <sup>4</sup>Queens College, <sup>5</sup>American Museum of Natural History, <sup>6</sup>Radio-Logic, Inc.

We have derived a method for quantifying some aspects of facial skeletal morphology in the papionins. The method involves recording 45 craniometric landmarks, as well as 15 ridge or space curves describing particular contours and proportions of the face, in the form of three-dimensional coordinate data. The purpose of this method is to quantify variation in facial morphology, both within and among species, in an attempt to allocate significant differences to sex, sub-species, larger taxa and compare fossil specimens.

Coordinates were recorded in Excel using a Microscribe-3DX 3-dimensional digitizer. This device has a precision of approximately 0.24 mm, including human error, in landmark location. Data from individual specimens are fitted to one another and aligned to a common coordinate system using Generalized Rotational Fitting of N-Dimensional Data (GRF-ND) written by Dennis Slice and software written for a UNIX work station. Landmarks are compared using squared distances from a consensus specimen. Curves are compared using a specific number of evenly spaced points along the lines.

A sample of specimens from extant papionin species have been digitized at the American Museum of Natural History, as well as a sample of extant and extinct papionins at the National Museum of Ethiopia. The method is capable of distinguishing sexes, subspecies, and higher taxa; and

depicting the differences in graphical displays of the skulls, as summarized by the landmarks.

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Post-conflict interactions in a small group of chimpanzees: group dynamics and individual effects. A. FUENTES, Dept. of Anthropology, Central Washington University, and M.J. HARVEY, Chimpanzee Human Communication Institute, Central Washington University, Ellensburg, WA 98926

Most of the recent surge of interest in the examination of post-conflict, or "reconciliatory", behavior has focused on two primate genera: *Macaca* and *Pan*. These studies involve varying degrees of manipulation of captive groups and report differences in post-conflict behavior between the two genera as well as within the genus *Macaca*. Much of this work focuses on general rates of post-conflict behavior and/or "reconciliatory" rates measured via PC/MC or similar methods. While there has been some debate as to the function and definitions of "reconciliation" and other post-conflict behavior little attention has been paid to the role that group specific dynamics and individual variation play in contributing to a given group's post-conflict behavioral profile.

Here we report the results of a six-week (150 hour) study of the post-conflict behavior in a small group of chimpanzees (*Pan troglodytes*) at the Chimpanzee Human Communication Institute at Central Washington University. The composition of this group has remained stable since 1981. Although four of the five individuals in this group were cross fostered by human caregivers all have been living exclusively in all chimpanzee groups for at least 17 years. General "reconciliation" occurred at approximately the same rate as reported for other captive chimpanzee groups. The intensity and frequency of conflict were very low and individuals varied dramatically in their type and rate of post-conflict behavior. Data from this study suggest that elements of a group's history, type and quality of captive environment, and behavioral differences among individuals may dramatically impact post-conflict behavioral profiles.

While it is very likely that differences in post-conflict behavior between genera are the result of phylogenetic differences, individual and specific group dynamics may play a major role in within species comparisons of these same behaviors.

Birth weight and gestational age: An analysis using mixture models. T.B. GAGE, The University at Albany, SUNY, Albany, NY 12222.

Recent studies have shown that birth weight and gestational age are well

described by mixtures of two normal distributions with unequal means and variances. One interpretation is that the "cause" of this heterogeneity is the same for both outcomes, however, a simpler hypothesis is that short gestational age accounts for heterogeneity in birth weight. This paper examines this second hypothesis.

The data consist of all singleton births to non-Hispanic European Americans, by sex within the state of New York during 1988. The analyses consist of fitting one and two component mixture models to birth weight while controlling for gestational age. Standard maximum likelihood procedures are used to identify the parsimonious model.

The results indicate that both short and normal gestational age birth cohorts are heterogeneous and composed of two or more components. A mixture of two normals with different means but similar variances and a single normal are all strongly rejected based on the likelihood ratio criterion. The results are weakest for low gestational age males where the single normal is rejected at the  $p < 1.0e^{-6}$  and the double normal with a single variance is rejected at  $p < .002$ . In the case of females about 92.4% of normal and 92.1% of short gestational age infants occur in the dominant ("normal" fetal development) component of birth weight. These results do not support the hypothesis that low gestational age accounts for heterogeneity in the birth weight distribution. Combining the two variables in a multivariate mixture model may further improve identification of infants at risk. These and other results are presented and discussed.

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Preliminary field study of positional behavior and habitat preference in *Callimico goeldii*. P.A. GARBER and J.A. REHG, Department of Anthropology, University of Illinois, Urbana, Illinois 61801.

Field studies of the behavior and ecology of *Callimico goeldii* are critical for understanding the evolution and adaptive radiation of callitrichine primates. The taxonomic position of *Callimico* within the Callitrichinae, however, remains unclear. Based on anatomical evidence *Callimico* is best considered an ancestral callitrichine and most closely related to tamarins of the genus *Saguinus*. Recent DNA evidence supports an alternative interpretation, that *Callimico* represents a highly derived lineage and shares a more recent common ancestry with marmosets (*Callithrix* and *Cebuella*). In this paper we present data collected during a preliminary field study of mixed species troops of *Callimico goeldii*, *Saguinus labiatus*, and *Saguinus fuscicollis* in northwestern Brazil and address the question of whether the behavioral ecology of *Callimico* is more consistent with a tamarin or marmoset affinity.

From May through July, 1997 the behavioral ecology of 3 callitrichine species was studied at Catuaba (10°S, 69°W), an 800 ha reserve administered by the Universidade Federal do Acre. This site contains areas

of bamboo forest and primary forest. A total of 15 km of trails within the reserve were mapped, and the locations of tamarin and *Callimico* groups were recorded. Data on activity patterns, habitat preference, and positional behavior were collected on focal animals at 2 minute intervals throughout the day. A total of 499 activity records were recorded for the 3 species.

Behavioral observations indicate marked differences in vertical height preference between callitrichine species. *Callimico* was consistently found to inhabit the lowest levels of the canopy, including the ground. Less than 2% of all activities occurred above a height of 16m. In contrast, *S. fuscicollis* spent 11% of its time above 16 m and *S. labiatus* 34%. *Callimico* was also distinct among the 3 species in displaying a hindlimb dominated form of bounding-hop during travel (15%) and in its high frequency of trunk-to-trunk leaping (70% of leaps began and/or ended on trunks). Based on these and other data we conclude that positional behavior and habitat utilization in *Callimico* are distinct from other callitrichines, but more similar to a tamarin-like rather than a marmoset-like condition. Additional relationships between habitat preference and positional behavior in callitrichines are discussed. This project was supported by a grant from the Research Board of the University of Illinois.

The smallest primate? D.L. GEB0, Northern Illinois University, DeKalb, IL 60115, M. DAGOSTO, Northwestern University, Chicago, IL 60611, K.C. BEARD, Carnegie Museum, Pittsburgh, PA 15213, and T. Qi, Institute of Vertebrate Paleontology and Paleontology, Academia Sinica, Beijing, 100044, China.

The Shanghuang fissures of Jiangsu Province, southeastern China (middle Eocene, Irudinmanhan and early Sharamurunion Land Mammal Ages) have yielded numerous specimens indicating a diverse radiation of primates. Among these specimens is a tiny calcaneus from Fissure A. Morphologically, it resembles North American omomyids, although it most likely belongs to a new family of haplorhine primates. It is remarkable for its incredibly small size, being only 4.0 mm in length. In comparison, the calcaneus of *Microcebus murinus* is 10 mm in length. Using three different regression equations from Dagosto and Terranova (1992), we arrive at an estimated body mass of 11.9 gms with a range from 9.4 to 14.6 gms. Thus, the size of this extinct primate is roughly 1/3 that of the smallest extant primate (*Microcebus myoxinus*, 30.2 gms)! This tiny body size places this fossil primate with some of the smallest mammals on record.

Left-right asymmetries in the temporoparietal intrasylvian cortex of common chimpanzees. E. GILISSEN, California Institute of Technology, Pasadena; K. AMUNTS, Vogt Institute, Duesseldorf, Germany; G. SCHLAUG, Beth Israel Deaconess Med Ctr, Boston and K. ZILLES, Vogt Institute, Duesseldorf, Germany

The perisylvian region is of particular interest for the study of structural correlates of cerebral functional

asymmetries in humans. Within this region, the planum temporale (PT) is an area on the posterior superior temporal gyrus. This area is mostly covered with higher-order auditory association cortex and corresponds to "Wernicke's speech area" in the left hemisphere. Numerous studies, from both postmortem and in vivo human brain, have described that in a majority of cases, the left PT is larger than the right. Measurements of the length of the left and right Sylvian fissures in humans show that the left Sylvian fissure is longer than the right. A similar, but less striking, asymmetry is observed in chimpanzees. Nevertheless, we have previously shown that sulcal length and intrasulcal depth do not necessarily correlate. Moreover, studies have shown that the human petalial pattern of fronto-occipital directional asymmetry is totally absent in chimpanzees. To test the hypothesis of an asymmetry in the temporal region of the chimpanzee, we evaluated the degree of PT surface area asymmetry in 3D magnetic resonance images obtained from formalin fixed brains of common chimpanzees.

Total surface area of PT was measured on each brain hemisphere with an image processing workstation (N=10; 5 females, 4 males, 1 sex unknown). For this purpose, the total length of the PT was determined on a series of subsequent sagittal slices. The cursor was traced manually within the gray matter of the supratemporal plane starting from the bottom of Heschl's sulcus and following the gyral and sulcal contours of the PT. Total length measurements on each single slice were summed up and multiplied with the slice thickness in order to obtain the PT total surface area. The difference between left and right PT total surface area was determined by the asymmetry coefficient  $\delta = (R - L) / 0.5(R + L)$ . Negative values indicate leftward asymmetry, positive values indicate rightward asymmetry.

Common chimpanzees showed a strong tendency for a left-larger-than-right PT approaching statistical significance (Sample Mean: -0.202; t Value: -1.638; P (1-tail): 0.0679). This result suggests that the onset of morphological asymmetry of language areas is part of an evolutionary process not limited to humans. Our thanks to J. Rademacher. This work was supported by the von Humboldt and the Fyssen Foundations and by HFSP grant and DFG grant SFB 194-A6.

Somatometric and Physiological Variations Among Adolescent Khasi Girls of Meghalaya. P.S. Gill, Univ of Cincinnati Med Ctr, Cincinnati, OH 45267, R.K. Pathak, North-Eastern Hill Univ, Shillong, India & P.A. Porter-Gill, Children's Hospital Medical Center, Cincinnati, OH 45229.

We have undertaken a cross-sectional growth study on the Khasi adolescent girls with the following objectives: 1) To find out the somatometric characteristics of "athletic" and "control" girls at different ages. 2) To assess physiological variations in age of the two samples. 3) To determine the extent of physical activity and indulgence in personal habits. 4) Lastly, to evaluate age changes in growth patterns between the two samples.

The tribal population of the Khasi follow a matrilineal system of society and speak a dialect of Monkhmer language (Austro-Asiatic). The subjects of the present study are school age Khasi girls attending Schools in Shillong. The athletic sample

(n = 191) consists of girls who play different sport on their school teams. The control sample (n = 195) consists of those girls who never participated in any sports in or outside school. The date of birth for each subject was obtained and converted to decimal age for formulating different age groups. Each subject has been measured for 8 somatometric variables (stature, weight, biacromial diameter, bicristal diameter, chest circumference, abdominal circumference, triceps circumference, triceps skinfold) and 3 physiological variables (Pulse rate, blood pressure and temperature).

In general, the athletic sample individuals are taller and heavier with broader shoulders and hips than the control sample. There is not much difference between the two samples for body fat and circumference. The youngest age group subjects in the athletic sample gave relatively higher values for blood pressure (systolic & diastolic).

Fossil primates and associated fauna from 1997 excavations at the middle Miocene site of Maboko Island, Kenya. S.N. GITAU, B.R. BENEFIT, M.L. McCROSSIN, and T. ROEDL. Department of Anthropology, Southern Illinois University, Carbondale, IL 62901.

A six-week programme of excavation was carried out on Maboko Island between May and July, 1997. Fourteen 2x2 m excavation units in Beds 3 and 5 of the Maboko Fm. were quarried and about 180 cubic metres of sediment were screen-washed. We recovered 969 identifiable vertebrate fossils, including 22 specimens of *Kenyapithecus*, 45 *Mabokopithecus* and *Nyanzapithecus*, 17 *Simiolus*, 327 *Victoriapithecus*, and one specimen of *Komba*. The most common non-primate mammal genera recovered were the water chevrotain *Dorcatherium* (185), the giraffoid *Climacoceras* (85), and the suid *Lopholistriodon* (18).

Fossils recovered from Bed 3 are concentrated in a paleosolic greenish-yellow sandy clay while those in Bed 5 occur in indurated clays of floodplain origin (Feibel & Brown, 1991). *Kenyapithecus*, *Simiolus*, *Victoriapithecus*, suids, and bovids occur with comparable frequency in both beds but there are contrasts in the relative abundance and associations of the primate and non-primate fauna. Collections from Bed 3 in this and previous seasons have yielded the large bushbaby *Komba winamensis* in association with a fauna dominated by *Climacoceras*, gomphotheres, and rhinocerotids but with few rodents (springhares) and only a single bird (a hornbill). The Bed 5 fauna differs in the abundance of oreopithecids and the presence of a very small bushbaby (*Komba* sp. nov.) together with a relatively greater abundance of *Dorcatherium*, several rodents (including thryonomyids, diamantomyids, bathyergids, and pedetids) and a diverse bird fauna (including flamingos, lily trotters,

cormorants, and aningas). Preliminary indications are that the paleoenvironment of Bed 5 is dominated by species more closely tied to aquatic environments and perhaps dense woodland while Bed 3 may represent a more open woodland environment.

These fine-scale aspects of paleoenvironment may help clarify the fundamental changes in primate evolutionary history that took place between the early and middle Miocene of Africa.

Optic canal and orbit size --implications for the origins of diurnality and visual acuity in primates. W. G. GONZALEZ, R.F. KAY, and E. C. KIRK. Biological Anthropology & Anatomy, Duke Medical Center, Durham, NC 27710

In an examination of the orbital anatomy of 49 extant species primates, we find that the optic canals of strepsirrhines (regardless of activity pattern) and nocturnal haplorhines (*Tarsius* and *Aotus*) are smaller than those of diurnal anthropoids when scaled to orbit size. This pattern may be due to the smaller number of efferent nerve fibers in optic nerves of species with a higher ratio of photoreceptor cells to ganglion cells (retinal summation). Indeed, data from Rohen & Castenholz (*Folia primatol.*, 5:92-147, 1967) indicate that strepsirrhines and nocturnal haplorhines have higher retinal summation than diurnal anthropoids. Because enhanced visual acuity is associated with reduced retinal summation, optic canal size provides a means of estimating the degree of visual acuity in extinct taxa.

Eocene/Oligocene omomyids (*Necrolemur*, and *Microchoerus*), adapids (*Leptadapis*, *Adapis*, and *Pronycticebus*), and the enigmatic *Plesiopithecus* (Egyptian late Eocene), have small optic canals suggesting a high degree of retinal summation and visual acuity comparable to extant strepsirrhines.

An alternative way to achieve greater visual acuity is to enlarge the eye, thereby increasing the absolute number of photoreceptors. Because the eyes of *Tarsius* and *Aotus* are proportionately much larger than those of nocturnal strepsirrhines, these taxa may have visual acuity comparable to diurnal haplorhines even though they have a high degree of retinal summation.

As previously noted by Kay & Cartmill (*J. Hum. Evol.*, 6: 19-54, 1977), orbit size permits an inference about activity pattern. Based on this criterion, a broad spectrum of activity patterns is inferred for Eocene/Oligocene primates. The orbits of most omomyids fall within the size range of nocturnal strepsirrhines, whereas those of most adapiforms suggest a diurnal activity period. The orbits of *Shoshonius* are larger than those of other omomyids but are not outside the extant strepsirrhine range. *Rooneyia* has small diurnal orbits. *Pronycticebus* and *Plesiopithecus* have large orbits and were probably nocturnal.

We propose that a decrease in retinal summation with a concomitant increase in visual acuity was an evolutionary innovation of crown haplorhines not seen in omomyids. Decreased retinal summation likely coincided with the acquisition of other adaptations for increased visual acuity including a retinal fovea, postorbital closure, and loss of a tapetum lucidum. A secondary return to greater retinal summation in the nocturnal *Tarsius* and *Aotus* is compensated for by the development of enormous eyes.

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